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BRAIN-COMPUTER INTERFACES AND THE RIGHT TO BE HEARD: CALIBRATING LEGAL AND CLINICAL NORMS IN PURSUIT OF THE PATIENT'S VOICE

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I. INTRODUCTION

Mary O'Connor had watched the slow deaths of several loved ones and emphasized to her daughters that she would not want such an outcome for herself.[1] O'Connor's adult daughters petitioned for removal of their now incapacitated mother from life support.[2] Nevertheless, the New York Court of Appeals rejected their plea in *In re Westchester County Medical Center* ("*O'Connor*"), stating that the support the daughters offered for this decision did not meet the standard of clear and convincing evidence.[3]

Law prioritizes obedience to established rules. Above all, it fears the type I error — the false positive, the conviction of an innocent. In this sense, law often errs on the side of test specificity. Medicine, meanwhile, has as its priority the care of patients, and its risk profile favors test sensitivity. Medicine is more concerned with a type II error, such as a missed diagnosis. While legal standards for clinical care protect the vulnerable, especially during decisions at life's end, these differing norms, grounded in statistical reasoning and consequentialism, do not

1. *In re* Westchester Cty. Med. Ctr., 531 N.E.2d 607 (N.Y. 1988).
2. *Id.* at 608–09.
3. *Id.* at 608.

operate in isolation. Indeed, norms from the law can have a direct impact on medical practice and public health,[4] as illustrated by cases like *O'Connor,* where legal standards co-opted a medical decision about care. In such cases, stringent legal standards can tyrannize a context of care where, for example, a standard of clear and convincing evidence is not required and in fact counterproductive. To demand this standard could restrict communication and undermine the care of patients.

Courts have recognized the potential dangers of overly protective standards for medical decisions. In *Cruzan v. Director, Missouri Department of Health*, the Supreme Court allowed states to set their own decision-making standards for end-of-life care.[5] After *O'Connor* and other similar cases, the New York State Department of Health established a new set of evidentiary regulations[6] that were legislated as the Family Health Care Decisions Act of 2010.[7] These standards helped to facilitate surrogate decision-making based on prior preferences, taking account of the patient's contemporaneous articulations.

While new technology can help foster an individual's ability to communicate, it sometimes creates ambiguity over how to handle information in medical contexts. When faced with uncertainty, physicians may act conservatively and seek refuge in familiar standards, like the high evidentiary standards attached to end-of-life decisions. As a result, physicians may retreat from the flexibility of a care-based ethic into the perceived security of the law's protective confines and bright-line rules, in contrast to situations where law provides little guidance on complex ethical issues at the intersection of law and bioscience.[8]

Such a dynamic may also occur when assessing brain-computer interface ("BCI") systems that will one day stand in for a patient's voice. BCI technology uses neural activity to allow paralyzed but conscious individuals to communicate.[9] But how will these communications be weighed and assessed? While this challenge may seem to be for the future, legal scholarship must look forward to advances in assisted

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4. *See, e.g.*, Zachary E. Shapiro, Elizabeth Curran & Rachel C. K. Hutchinson, *Cycles of Failure: The War on Family, The War on Drugs, and The War on Schools Through HBO's The Wire*, 25 WASH. & LEE J.C.R. & SOC. JUST. 183, 216–18 (2019); Christine M. Baugh & Zachary E. Shapiro, *Concussions and Youth Football: Using a Public Health Law Framework to Head Off a Potential Public Health Crisis*, 2 J.L. & BIOSCIENCES 449 (2015).

5. *See* 497 U.S. 261, 281 (1990).

6. *See* THE N.Y. STATE TASK FORCE ON LIFE & THE LAW, WHEN OTHERS MUST CHOOSE: DECIDING FOR PATIENTS WITHOUT CAPACITY (1992).

7. *See* A.B. 7729-D, 2009 Assemb., 2009–2010 Reg. Sess. (N.Y. 2010); S.B. 3164-B, 2009 S., 2009-2010 Reg. Sess. (N.Y. 2010).

8. *See* JOSEPH J. FINS, A PALLIATIVE ETHIC OF CARE: CLINICAL WISDOM AT LIFE'S END 158–59 (2006); *cf.* Zachary E. Shapiro, *Savior Siblings in the United States: Ethical Conundrums, Legal and Regulatory Void*, 24 WASH. & LEE J.C.R. & SOC. JUST. 419 (2018).

9. Jonathan R. Wolpaw & Elizabeth Winter Wolpaw, *Brain-Computer Interfaces: Something New Under the Sun*, *in* BRAIN-COMPUTER INTERFACES: PRINCIPLES AND PRACTICES 3, 4 (Jonathan R. Wolpaw & Elizabeth Winter Wolpaw eds., 2012).

communication using BCI technology and propose anticipatory governance.[10]

In this Article, we will pose a number of critical questions for individuals utilizing BCI technology: Will individuals be evaluated using standard measures to assess capacity and legal competency? Will they be assessed neutrally or be subject to techno-skepticism? How much fidelity to the human voice will BCI communication need to achieve to be accepted? Though dilemmas like malfunctioning software might, in fact, be more remediable than disputes between dueling surrogate decision-makers over a patient's prior wishes, the novelty of neuroprosthetic communication raises novel challenges that could lead to misplaced remedies and inappropriate standards.

BCI technology deserves special attention, both legally and clinically, as medical technology's best hope for patients with severe brain injuries to assert their wishes. Tragedies like *Hacienda Healthcare* illuminate the abuse to which patients, lacking any tools for self-advocacy, are vulnerable. Other patients who cannot use BCI may face abandonment, lack of pain medication, or other forms of abysmal maltreatment.[11] Overly stringent knowledge standards or excessively cautious physicians risk damaging the everyday quality of life for BCI users and subjecting BCI users to dignity violations.

In the spirit of anticipatory governance, and looking toward advances in neuroscience and computing technology in the coming decades,[12] this Article examines the issues raised by usage of BCI technology in the legal and medical clinical contexts. While BCI technology can fit within conventional legal frameworks, this Article argues against allowing restrictive legal standards to dominate more routine decisions in clinical practice or choices made by BCI-assisted patients in daily life. While those making end-of-life decisions may also require BCI technology, many of the quotidian choices that BCI users make involve much less weighty communication. To deprive these individuals of a newfound ability to communicate is to disrespect their personhood on procedural grounds, and so deny their right to be heard. To help prevent this affront to dignity and still protect patients from the

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10. *Cf.* David H. Guston, *Understanding 'Anticipatory Governance'*, 44 SOC. STUD. SCI. 218, 220 (2014) (discussing potential benefits of anticipatory governance to the field of nanotechnology).

11. *See* Vanessa Romo, *Nursing Home Launches New Investigation After Woman in Vegetative State Gives Birth,* NPR (Jan. 14, 2019, 9:49 PM), https://www.npr.org/2019/01/14/685377950/nursing-home-launches-new-investigation-after-woman-in-vegetative-state-gives-bi [https://perma.cc/Y4TR-6AXF]; Joseph J. Fins, *When No One Notices: Disorders of Consciousness and the Chronic Vegetative State*, HASTINGS CTR. REP., July–Aug. 2019, at 14; JOSEPH J. FINS, RIGHTS COME TO MIND: BRAIN INJURY, ETHICS, AND THE STRUGGLE FOR CONSCIOUSNESS 151 (2015).

12. *See generally* Zachary E. Shapiro, *Bioethics in the Law*, HASTINGS CTR. REP., Jan.–Feb. 2017, at 1 (explaining how law, when coupled with an understanding of science, can impact the practice of medicine and public health).

burden of decisions that they may not yet be able to undertake, we propose to consider the role that BCI technology might eventually play in patient communication.

In Part II of this Article, we will outline the principles of BCI design and usage, so that an understanding of the technology can guide legal and clinical decisions. Part III discusses populations of potential users and how they could employ BCI technology to reclaim their independence. The Article will then turn in Part IV to legal issues hastened by BCI technology, particularly capacity, competence to stand trial, and the rules of evidence. Part V will consider the analogous constructs of capacity, competence, and certainty as they appear in medical practice. Finally, in Part VI, we reflect on the obligations we owe to users of BCI prosthetics and how we as a professional community can use these tools to respect and empower others.

II. BRAIN-COMPUTER INTERFACES: PRINCIPLES AND DESIGNS

A brain-computer interface, in the words of Jonathan and Elizabeth Winter Wolpaw, "measures activity from the central nervous system and converts it into artificial output that replaces, restores, enhances, supplements, or improves natural [central nervous system ('CNS')] output and thereby changes the ongoing interactions between the CNS and its external or internal environment."[13] A BCI typically pairs neural output with a computer application that responds in a predetermined way to brain activity.[14] BCI technology is most commonly, but not exclusively, used in patients with intact cognition but impaired motor output, often due to a spinal cord lesion.[15]

BCI technology requires users to intentionally produce specific neural output in order to interact with the application. A BCI may create an alternative interface to a preexisting technology for people who cannot use the original, as in an electroencephalography ("EEG")-controlled cursor rather than a mouse manipulated by hands.[16] Alternately, a BCI may furnish an assistive communicative device or a prosthetic. Thus, BCI is a type of assistive technology, a class of devices engineered to bridge the gap between capabilities and desired function

13. Wolpaw & Wolpaw, *supra* note 9, at 3.

14. *Id.*

15. *See id.* at 4.

16. *See, e.g.*, Beata Jarosiewicz et al., *Virtual Typing by People with Tetraplegia Using a Self-Calibrating Intracortical Brain-Computer Interface*, SCI. TRANSLATIONAL MED., Nov. 11, 2015, at 1.

in individuals with disorders secondary to motor dysfunction or cognitive impairment.[17] This Article will focus mainly on assistive communicative BCI. These may take the forms of spelling or word generation, ideally supplemented with predictive typing technology or synthetic voices.

In the following section, we consider different forms of BCI technology. These range from non-invasive modalities like word boards, EEG, and neuroimaging, to invasive methods that surgically insert electrodes into the brain. The following examples are intended to represent the problem space and to model a heuristic for legal and medical implications.

A. Non-Invasive BCI

The simplest, earliest assistive communicative devices were word boards or Morse code-like systems.[18] These consisted of some system of characters or words, ordered either alphabetically or by frequency of use. Patients cooperated with a partner, who would indicate options until the patient blinked to select an option.[19] The more modern versions of this involve electrooculography, or eye tracking, in which a camera detects the direction and speed of an individual's gaze as they scan the word board.[20] Users can select options by lingering on the character of choice, which can then lead to language output.[21] While simple, cost-effective, and easy to learn, eye tracking is not an option for all patients. Traumatic injuries can sever the nerves providing ocular control, and the late stages of neurodegenerative diseases like ALS can also inhibit patients' voluntary control over their eyes.[22] The mandate to respect personhood throughout brain injury cannot be upheld if patients lose their sole method of communication just when their disease worsens and they are most vulnerable.

Thus, researchers are continually developing new models of brain-based computer applications, which the patient could operate so long as they are conscious. With non-invasive BCIs, researchers can maximize recording accuracy through design considerations. For instance, designers can calibrate their recording and reference electrode place-

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17. Jane E. Huggins & Debra Zeitlin, *BCI Applications*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 197, 197.

18. *Id.*

19. *Id.* at 200.

20. *Id.*

21. *Id.*

22. *See* Rakesh Sharma et al., *Oculomotor Dysfunction in Amyotrophic Lateral Sclerosis: A Comprehensive Review*, 68 ARCHIVES NEUROLOGY 857, 859 (2011).

ment differentially depending upon the neural response they are seeking to capture.[23] So-called "active electrodes," which amplify the signal at its source, are available from many vendors.[24] As with invasive BCIs, a ground electrode must always be used to help remove noise.[25] Non-invasive BCIs are more susceptible to the risks of artifact, or electrical activity from movement within the body, such as from the muscles ("electromyography" or "EMG") or eyes ("electrooculography" or "EOG"), which interferes with collecting the neural electrical activity.[26] While this may pose less of a concern for locked-in patients, who generally cannot move, artifact can potentially corrupt the neural signal and confound BCI use in other patient populations.[27] EOG and EMG tend to have stereotyped waveforms, so methods exist for filtering them out computationally.[28]

Non-invasive BCIs can also allow for more creative solutions for patient comfort. Designers can choose to use either wet or dry electrodes. While wet electrodes tend to gather signals more reliably, in the past they have also been cold, sticky, and uncomfortable. Newer, sleeker models use saline solution and comfort pads.

23. *See, e.g.*, Ramesh Srinivasan, *Acquiring Brain Signals from Outside the Brain*, in BRAIN-COMPUTER INTERFACES, *supra* note 9, at 105, 105–07, 111–13.
24. *Id.* at 106.
25. *Id.* at 105.
26. *Id.* at 108–09.
27. *See id.*
28. *See id.* at 109.

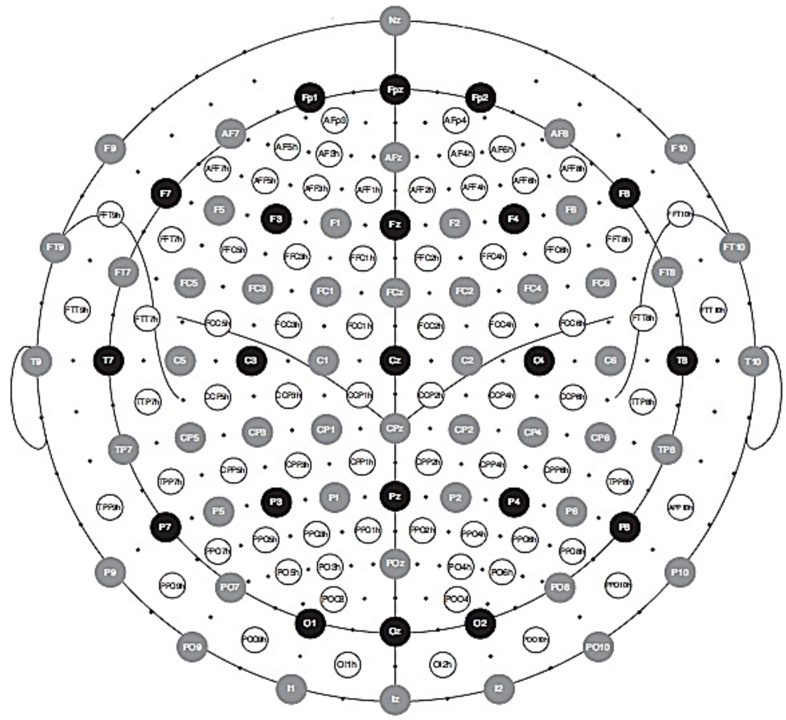

Figure 1. Standardized Placement Chart of EEG Electrodes with Names Given For Each Location.[29]

B. EEG-Based Communication

Electroencephalograms, measured by sensors applied to the scalp, register the electrical signals that brain cells, or neurons, emit when they activate.[30] EEG records the electrical activity of the many neurons firing at any given time, as the result of both conscious and unintentional neural activity. In BCIs, this output then prompts the application to change in some predictable manner. One neurological change is an event-related potential ("ERP"), or a predictable spike in neural activity in a certain area of the brain that is tied to a particular event.[31] This may occur in the motor, parietal, or premotor cortex, or can even be tied to

29. Srinivasan, *supra* note 23, at 108.

30. *See generally* Paul L. Nunez, *Electric and Magnetic Fields Produced by the Brain*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 45; Zachary E. Shapiro, Note, *Truth, Deceit, and Neuroimaging: Can Functional Magnetic Resonance Imaging Serve as a Technology-Based Method of Lie Detection?*, 29 HARV. J.L. & TECH. 527 (2016).

31. *See* Eric W. Sellers, Yael Arbel & Emanuel Donchin, *BCIs That Use P300 Event-Related Potentials*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 215.

the activity of a single neuron. Because of the reliability of these responses and the close temporal resolution of EEG, neuroscientists can plan for this signal to occur in conjunction with a tracked event, such as when a desired character appears onscreen.[32] The counterpart to ERP is the steady-state evoked potential, which results in stable oscillations provoked by a continuous pattern. Though the paradigms oppose each other — one captures the response by a sudden change, the other by a steady pattern — both operate by predictable neural activity solicited by the application.[33]

One example of an ERP-based BCI is the P300-spelling matrix, a standard for BCI design.[34] In it, rows and columns of a six-by-six matrix are randomly selected several times per second while a trained classifier detects those rows and columns for which a certain EEG response occurs. By recognizing the row and column, the device is able to map out and express the desired letter.

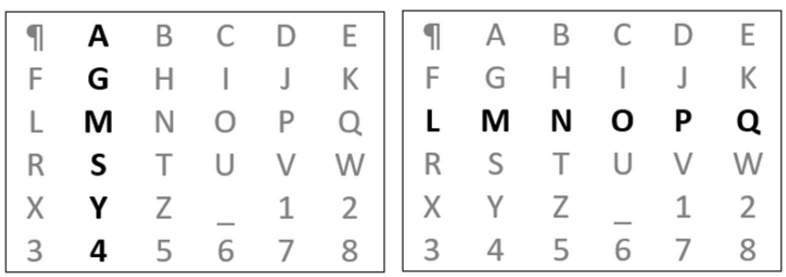

Figure 2. Standard Visual P300 Speller.[35]

An emerging style, which operates by a similar principle, is known as an N200 motion-onset visual response speller.[36] This method displays a matrix with a simple box next to each letter. In the boxes, colored objects move so as to elicit a motion-onset visual response in the viewer. The user attends to the letter they wish to select and performs a color recognition task, and the computer is then able to ascertain the column and row of the chosen letter.

32. *See id.*; John P. Donoghue, *BCIs That Use Signals Recorded in Motor Cortex*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 265; Hansjörg Scherberger, *BCIs That Use Signals Recorded in Parietal or Premotor Cortex*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 289.

33. *See* Brendan Z. Allison, Josef Faller & Christa Neuper, *BCIs That Use Steady-State Visual Evoked Potentials or Slow Cortical Potentials*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 241.

34. *See* Anderson Mora-Cortes et al., *Language Model Applications to Spelling with Brain-Computer Interfaces*, 14 SENSORS 5967, 5969 (2014).

35. *Id.* at 5970.

36. *See* Dan Zhang et al., *An N200 Speller Integrating the Spatial Profile for the Detection of the Non-Control State*, J. NEURAL ENGINEERING, Apr. 2012, at 1.

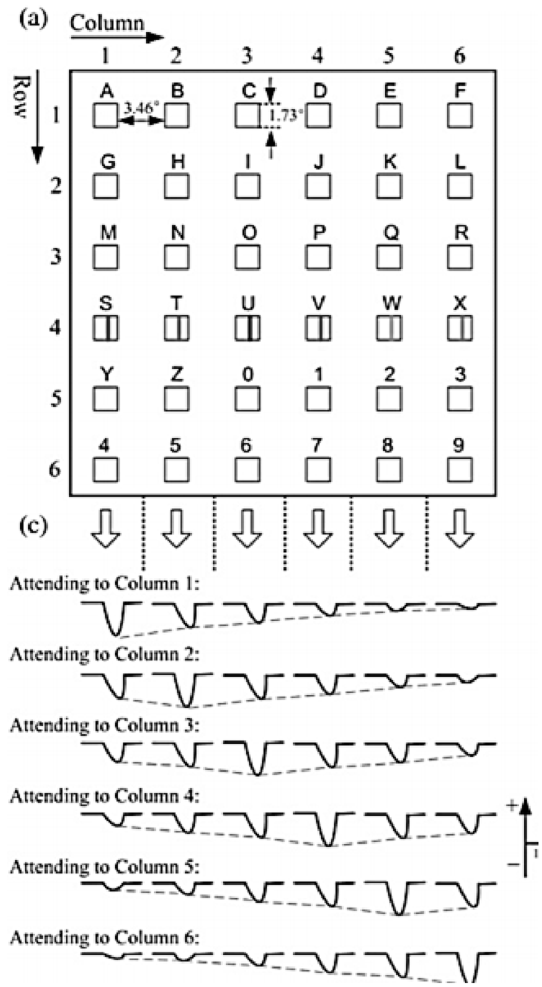

Figure 3. N200 Motion-Onset Visual Response Speller.[37]

Whereas the above styles evoke a predictable response from the user, another style for EEG-based BCI hinges upon a signal willfully produced by the user, to which the machine is then taught to respond. This method, known as biofeedback, has been used therapeutically for several decades, teaching individuals to produce certain brainwaves by locking the presence of that brainwave to a visual or auditory stimulus.[38] When using such a BCI, users conjure thoughts of a physical activity, a mood or state of consciousness, or any other sort of mental

37. *Id.* at 3.

38. Janis J. Daly & Ranganatha Sitaram, *BCI Therapeutic Applications for Improving Brain Function*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 351.

imagery that can be differentiated by an algorithm.[39] The computer then learns to recognize the brain signals and change the application screen in their presence, as in the case of the Hex-o-Spell.[40] This interface operates by two trained brain states.[41] One rotates an arrow, another stops it for selection. Users can spin the arrow until they reach the section containing their desired letter, and then repeat the process to access it.

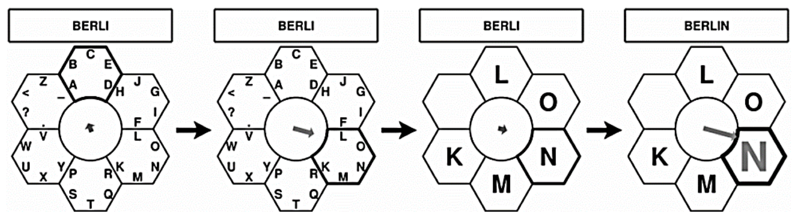

Figure 4. A Diagram of Selection Within the Hex-O-Spell System.[42]

C. fMRI-Based Communication

Another non-invasive approach involves brain imaging. Functional magnetic resonance imaging ("fMRI") maps neural metabolic signals, revealing the movement of blood throughout the brain.[43] Increases in blood flow reflect increased metabolic activity, or utilization of that area of the brain.[44] A region of the brain is said to be "activated" — in use or involved in conscious thought — when more blood is flowing to the region than the rest of the brain or compared to a previous time.[45]

Users can communicate from within fMRI by producing a thought that predictably activates a region of interest ("ROI") in the brain, and which is predetermined to have a certain meaning.[46] For example, in experimental work, investigators have asked subjects to imagine playing tennis, which reliably maps to the motor cortex, and walking about the subject's home, which maps to the spatial parietal lobe.[47] Thereafter, investigators can ask subjects to imagine playing tennis when they

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39. *Id.*

40. *See* Benjamin Blankertz et al., *The Berlin Brain-Computer Interface Presents the Novel Mental Typewriter Hex-O-Spell*, PROC. 3RD INT'L BRAIN-COMPUTER INTERFACE WORKSHOP & TRAINING COURSE 2006, Sept. 21–24, 2006, at 108–09.

41. *Id.*

42. *Id.* at 109.

43. *See* Shapiro, *supra* note 30, at 530–32.

44. *Id.*

45. *Id.* at 530–31.

46. *See* Martin M. Monti et al., *Willful Modulation of Brain Activity in Disorders of Consciousness*, 362 NEW ENG. J. MED. 579, 580–81 (2010); *see also* Adrian M. Owen & Martin R. Coleman, *Functional MRI in Disorders of Consciousness: Advantages and Limitations*, 20 CURRENT OPINION NEUROLOGY 632, 632–33 (2007).

47. *See, e.g.*, Monti, *supra* note 46, at 581; Owen & Coleman, *supra* note 46, at 634.

want to say "yes," and walking around their house if they want to say "no." The former response will activate an ROI in the motor cortex, the latter an ROI in the parietal lobe.[48] So distinguished, a patient otherwise unable to communicate will be able to do so.[49]

While fMRI boasts high spatial resolution, it constrains the user physically and is costly, making it impractical for everyday life.[50] Moreover, the constraints of this system have thus far limited the user to indicating only two options, yes or no, whereas other BCI modalities have already enabled greater vocabularies.[51] Thus, fMRI currently seems unlikely to displace EEG as the chief modality for BCI.

D. Invasive BCI

Invasive BCI may be able to provide greater accuracy than non-invasive versions and involves the surgical placement of electrodes inside the brain. Like any surgical procedure, implantation carries risks, especially for patients with pre-existing conditions. The most common risks are bleeding, infection, and localized tissue damage.[52] Nevertheless, surgical implantation of electrodes is considered safe enough that, in other therapeutic settings, such as deep brain stimulation ("DBS") for Parkinson's treatment,[53] the Centers for Medicare & Medicaid Services ("CMS") cover the cost of the procedure through Medicare.[54] Thus, an invasive BCI may be appropriate given its potential for improved precision and recording accuracy.[55]

There are additional issues of immune response to surgically implanted devices, such as local inflammation, which can increase electrical impedance. This response can cause indwelling devices to malfunction over time.[56] Nonetheless, these risks can be reduced, for instance, by using biocompatible microelectrodes and microwire arrays with long-term stability.[57] Technology is improving to lessen the risks

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48. *See* Owen & Coleman, *supra* note 46, at 634.

49. *See* Monti, *supra* note 46, at 588.

50. *See* Shapiro, *supra* note 30 at 535.

51. *See, e.g.*, Mora-Cortes et al., *supra* note 34, at 5969–82; Zhang et al., *supra* note 36, at 9–10; Blankertz et al., *supra* note 40, at 108.

52. *See* Kevin J. Otto, Kip A. Ludwig & Daryl R. Kipke, *Acquiring Brain Signals from Within the Brain*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 81, 92.

53. *See* Joseph J. Fins, *Deep Brain Stimulation*, *in* BIOETHICS 817, 819 (Bruce Jennings ed., 4th ed. 2014).

54. *See* Memorandum from Steve Phurrough, Dir., Div. of Med. & Surgical Servs., Coverage & Analysis Grp., Ctrs. for Medicare & Medicaid Servs. et al., to Administrative File CAG: #00124N Deep Brain Stimulation (DBS) for Parkinson's Disease (Feb. 6, 2003), https://www.cms.gov/medicare-coverage-database/details/nca-decision-memo.aspx?NCAId=21 [https://perma.cc/D6ET-KC8Q] [hereinafter Phurrough Memorandum].

55. *See* Otto, Ludwig & Kipke, *supra* note 52, at 90–91.

56. Joseph J. Fins, *Nanotechnology, Neuromodulation & The Immune Response: Discourse, Materiality & Ethics*, BIOMEDICAL MICRODEVICES, Apr. 2015, at 1, 3.

57. *See* Otto, Ludwig & Kipke, *supra* note 52, at 82.

of both device and biological failure by helping to eliminate interference by electrical fields outside of the brain, known as "noise."[58]

Newer studies have achieved promising results with intracranial EEG, which records electrical activity from underneath the skull but not within the brain.[59] This technique can yield higher-quality recordings without the medical and technical risks that come from penetrating brain tissue.[60] A research collaboration known as BrainGate has produced an invasive BCI with high accuracy that uses a keyboard-like application controlled by an EEG-based digital mouse.[61]

A final issue associated with invasive BCI is the fate of indwelling devices over time. There are still unknowns about what to do with BCI systems when they no longer function or need replacement, or if users decide that they do not want to have them inside their heads. While these issues are yet to enter the legal and ethical debate about invasive devices fully, some argue that there is a normative, and perhaps legal, obligation to make long-term provisions for these devices once they have been implanted, whether it is in a clinical trial or in clinical practice.[62]

III. Populations of BCI Users

A diverse population of patients might benefit from communicative BCI technology. Potential beneficiaries include those with normal cognition and impaired motor output, as in locked-in syndrome; those with expressive communication difficulties (aphasia) secondary to stroke; and those who have both some degree of cognitive impairment and decreased motor output (patients with cognitive motor dissociation, as in those with disorders of consciousness). We will consider, in turn, each group of patients and the ways BCI might assist and empower them.

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58. *Id.* at 90–91.

59. *See* Gerwin Schalk, *BCIs That Use Electrocorticographic Activity*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 251.

60. *Id.*

61. *See* Jarosiewicz et al., *supra* note 16, at 2–3, 7. DBS is another technique involving the surgical implantation of electrodes into the brain, but in this case it is to therapeutically deliver electrical stimulation rather than to record ongoing neuroelectric activity. *See* Fins, *supra* note 53; Phurrough Memorandum, *supra* note 54. DBS patients may also require a communicative BCI, but DBS is not itself a neuroprosthetic communicative device. For this reason, though we reference DBS in some sections, we have omitted it here.

62. *See, e.g.*, Joseph J. Fins, *Deep Brain Stimulation, Deontology and Duty: The Moral Obligation of Non-Abandonment at the Neural Interface*, J. NEURAL ENGINEERING, Oct. 2009, at 1, 2–3.

A. Locked-In Syndrome

In many ways, the locked-in patient is a prototypical candidate for a BCI. Patients affected by locked-in syndrome ("LIS") have normal cognition but no motor output beyond the cranial nerves above the spine. Because of this, locked-in patients remain fully conscious but lack an ability to communicate. LIS can result from amyotrophic lateral sclerosis ("ALS"), commonly known as Lou Gehrig's disease, or from other neuromuscular disorders, stroke or traumatic brain injury ("TBI").

LIS was poignantly depicted in *The Diving Bell and the Butterfly,* a memoir written by Jean-Dominique Bauby, who suffered from this condition.[63] A former editor of the French *Elle*, Bauby sustained a stroke that left him in a locked-in state, with normal consciousness but no motor activity save for some facial gestures and the ability to blink.[64]

Bauby retained the love of his family, who continued to call and visit despite knowing that he could not respond to them.[65] With the help of his speech therapist Sandrine, Bauby developed a Morse code-like system whereby he could blink to indicate individual letters. The system he used to communicate consisted of a partner rapidly reciting a frequency-ordered alphabet, choosing the spoken letter whenever Bauby blinked.[66] Laboriously, character by character, Bauby sent his loved ones a letter detailing his thoughts and experiences. After sending his first communication, Bauby soon started sending a monthly missive to his friends and family. Many in his circle responded to this newsletter, enabling him to remain involved with the people and issues he loved.[67] Eventually, using this same partner-assisted spelling system, he authored his bestselling memoir.[68]

As tragic as his case was, Bauby was lucky. Although he could not speak and was institutionalized, his normal cognition was identified and he was provided with an opportunity to communicate again. Many others are not so fortunate. Janet Tavalaro, a woman with LIS, was misidentified as being in a vegetative state, as she eventually recounted in her own memoir *Look Up for Yes*.[69] Each of these narratives illustrates the persistent hunger for communication amongst locked-in patients and the commensurate need to identify these patients and productively respond. Without the creativity and sensitivity of his speech therapist,

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63. *See* JEAN-DOMINIQUE BAUBY, THE DIVING BELL AND THE BUTTERFLY 3 (Jeremy Leggatt trans., Alfred A. Knopf 1997).
64. *See id.*
65. *See id.* at 69.
66. *See id.* at 20.
67. *See id.* at 81–82.
68. *See id.* at 2.
69. *See* FINS, *supra* note 8, at 151.

Bauby would have remained isolated, trapped in his head. Today, a patient in his position would no longer require such a cumbersome, code-dependent communication system. They could instead use a BCI. Still, as in Bauby's case, locked-in BCI users would require a circle of invested conversation partners with whom to speak.

B. Aphasia

Aphasia, a disorder affecting the ability to speak, affects about one in four stroke patients.[70] The condition may manifest as receptive, impacting understanding of others' words, or expressive, damaging one's own production of speech.[71] In some cases of expressive aphasia, patients are perfectly aware, and distressed, at their inability to generate the right words; in other instances, patients may be indignant that nobody can understand their word choice.[72]

Consider the case that Dr. Joseph Fins recounted when his father had a transient ischemia attack, a mini-stroke, which temporarily left him aphasic.[73] After his father recovered his ability to speak, Fins recalled a distressing encounter during his father's assessment. The testing neurologist held up a pen and asked Fins' father to identify it. His aphasic father could not summon the word "pen," but instead stated the location, "Germany," where the neurologist's pen was manufactured. Rather than prying into this response, the neurologist dismissed him as unable to recognize the pen.[74] Such lapses might be remediated by BCI systems designed specially for aphasia, and researchers have begun to develop ways to return communicative power to aphasic patients. One group has undertaken to decode intended speech from among neural signals and thus create a "speech prosthesis."[75] Going forward, such use cases will require special effort from lawyers, doctors, and loved ones to ensure receptive aphasia patients understand instructions.[76]

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70. Theresa M. Vaughan, Eric W. Sellers & Jonathan R. Wolpaw, *Clinical Evaluation of BCIs*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 325, 327.

71. *See* JOSEPH M. WEPMAN, RECOVERY FROM APHASIA 38–39, 142 (Ronald Press, 1951).

72. *Id.*

73. Joseph J. Fins, *Toward a Pragmatic Neuroethics in Theory and Practice*, *in* DEBATES ABOUT NEUROETHICS: PERSPECTIVES ON ITS DEVELOPMENT, FOCUS, AND FUTURE 45, 54 (Eric Racine & John Aspler eds., 2017).

74. *Id.*

75. *See* Jonathan S. Brumberg et al., *Brain-Computer Interfaces for Speech Communication*, 52 SPEECH COMM. 367, 367 (2010).

76. *See* Leigh R. Hochberg & Kim D. Anderson, *BCI Users and Their Needs*, *in* BRAIN-COMPUTER INTERFACES, *supra* note 9, at 317, 321–22.

C. Disorders of Consciousness and Cognitive Motor Dissociation

Disorders of consciousness are a suite of conditions identified by the lack of a liminal state of consciousness, including coma, the vegetative state, and the minimally conscious state.[77] Coma is an eyes-closed state of unresponsiveness.[78] The vegetative state ("VS") represents the isolated recovery of the brain stem, which is responsible for autonomic functions.[79] Vegetative patients are in a state of wakeful unresponsiveness in which there is no awareness of self, others, or the environment.[80] Though the patient may exhibit autonomic behaviors like blinking, these motions are not purposeful and do not reflect conscious awareness.[81] These patients are often confused with those in the minimally conscious state ("MCS"), a higher state of consciousness than the VS.[82] The MCS is a state of liminal consciousness characterized by intermittent evidence of awareness of self, others, and the environment.[83] MCS patients may sometimes, and unreliably, track people coming into their rooms, grasp for a cup, or even say their names.[84] The challenge is that these behaviors are episodic and unreliable. The inconstancy of these behaviors results in frequent misdiagnosis and conflation with the VS.[85] Patients in the MCS are thus at risk of "covert consciousness," having their signs of awareness dismissed or overlooked.[86]

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77. Joseph T. Giacino et al., *Disorders of Consciousness After Acquired Brain Injury: The State of the Science*, 10 NATURE REV. NEUROLOGY 99, 100 (2014).

78. FRED PLUM & JEROME B. POSNER, THE DIAGNOSIS OF STUPOR AND COMA 5 (3d ed. 1982).

79. *Id.* at 6.

80. Bryan Jennett & Fred Plum, *Persistent Vegetative State After Brain Damage: A Syndrome in Search of a Name*, 299 LANCET 734, 736 (1972).

81. *See* PLUM & POSNER, *supra* note 78, at 54. The vegetative state is said to be "persistent" if it lasts one month. Until September 2018, the vegetative state was said to be "permanent" if its duration was more than three months after anoxic brain injury and twelve months after traumatic brain injury. *See* The Multi-Society Task Force on PVS, *Medical Aspects of the Persistent Vegetative State (First of Two Parts)*, 330 NEW ENG. J. MED. 1499, 1499 (1994); The Multi-Society Task Force on PVS, *Medical Aspects of the Persistent Vegetative State (Second of Two Parts)*, 330 NEW ENG. J. MED. 1572, 1575 (1994). In September 2018, the "permanent" designation was changed to the "chronic vegetative state." For ethical, legal and clinical implications of these new practice guidelines, see Joseph J. Fins & James Bernat, *Ethical, Palliative, and Policy Considerations in Disorders of Consciousness*, 91 NEUROLOGY 471, 471 (2018).

82. *See* J.T. Giacino et al., *The Minimally Conscious State: Definition and Diagnostic Criteria*, 58 NEUROLOGY 349, 349 (2002).

83. *Id.* at 351.

84. *Id.*

85. Caroline Schnakers et al., *Diagnostic Accuracy of the Vegetative and Minimally Conscious State: Clinical Consensus Versus Standardized Neurobehavioral Assessment*, BMC NEUROLOGY, July 21, 2009, at 1, 1 (highlighting that up to 40% of MCS patients are misdiagnosed as vegetative).

86. *See generally* Fins & Bernat, *supra* note 81.

More broadly considered, both locked-in patients and those with covert consciousness, such as MCS patients, suffer from some degree of cognitive motor dissociation ("CMD"), in which cognitive capabilities elude behavioral manifestation because of inadequate motor output.[87] BCI systems could assist CMD patients in two main respects. First, by providing a means of communication, a BCI could help families and doctors screen for conscious understanding by observing consistent patterns of logical responses. These "conversations" could even be recorded to provide critical evidentiary information, thus preventing the dilemma where an intermittently conscious patient is dismissed by a clinician who cannot replicate the command-following. This could help improve diagnostic accuracy and prevent patients from being mislabeled.

Moreover, BCI systems could immediately improve quality of life by helping patients express their wishes. If BCI technology gives an ability to communicate, this can allow patients to express their needs and refuse to be ignored. If BCI technology can be introduced at the early stages of a progressive neuromuscular disease such as ALS, patients can learn to use the device while still independent so that they can comfortably rely upon it later. They can also work with their clinicians to modify the device to their own specifications. For these patients, knowing that they will retain a way to be close to their loved ones and exercising a measure of control over the device's functioning may improve their overall well-being.

IV. BCI AND THE LEGAL SYSTEM

BCI technology has the potential to give voice to patients burdened by LIS, aphasia, or cognitive-motor dissociation. While this is a promising step forward for those heretofore silenced by injury or disease, the prosthetic communications of these patients remain vulnerable and prone to misunderstandings. Even with BCI assistance, and even with sincerest intentions to respect the patients' personhood and due process rights, patient agency can be compromised by halting or incomplete communication.[88]

In the following sections, we explore legal issues raised by BCI, and how conventional legal frameworks for capacity, competence to

87. *See* Nicholas T. Schiff, *Cognitive Motor Dissociation Following Severe Brain Injuries*, 72 JAMA NEUROLOGY 1413, 1414 (2015).

88. *See* Joseph J. Fins, *Mosaic Decisionmaking and Reemergent Agency After Severe Brain Injury*, 27 CAMBRIDGE Q. HEALTHCARE ETHICS 163, 165–69 (2018) (proposing a system of shared decision-making for individuals with brain injuries); Joseph J. Fins, *Mosaic Decisionmaking and Severe Brain Injury: Adding Another Piece to the Argument*, 28 CAMBRIDGE Q. HEALTHCARE ETHICS 737, 738–40 (2019).

stand trial, and evidence may intersect with BCI and the emergent communication made possible by this technology.

A. Capacity

In law and medicine, capacity functions in a modular fashion: a patient may have the capacity to consent to a procedure but not, for instance, to contract. Informed consent motivates the legal and clinical understanding of capacity.[89] Legally, the capacity to consent to medical procedures runs "parallel" to the capacity to contract.[90] Both medicine and law possess professional and ethical guidelines to help practitioners analyze complicated situations when capacity is unclear.[91]

Often, lawyers can immediately judge capacity, and so the Model Rules of Professional Conduct ("MRPC") may be overlooked in favor of common sense. Patients with the neurological impairments discussed above invert this trend. Instinct, bias, and a lack of experience with such patients would ordinarily lead lawyers to discount the capacity of a non-communicative, unresponsive individual, unless they have specifically been trained to screen for neurological impairments that affect ability to express capacity but not capacity itself. This trend may be exacerbated by the uncommon nature of many of these conditions and the rare appearance of these cases in court. As a result, most lawyers will not get the requisite experience with these patients to carefully interrogate their own biases and presumptions. For this reason, the MRPC can be especially useful when assessing vulnerable populations for decisional status.

Lawyers can look to state, federal, and ethical guidelines on capacity judgments, which are often codified in state advance directive laws. A definition from the Uniform Health Care Decisions Act is prototypical: "'*Capacity*' means an individual's ability to understand the significant benefits, risks, and alternatives to proposed health care and to make and communicate a health-care decision."[92] The basic framework presumes that adult patients have the capacity to consent, and states will set their own burdens of proof to demonstrate otherwise. For instance, in Washington State, the evidentiary burden to overturn an apparent decision is the standard of clear and convincing evidence.[93]

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89. AM. BAR ASS'N COMM'N ON LAW AND AGING & AM. PSYCHOLOGICAL ASS'N, ASSESSMENT OF OLDER ADULTS WITH DIMINISHED CAPACITY: A HANDBOOK FOR LAWYERS 5–6 (2005).

90. *Id.* at 6.

91. *See id.*

92. *Id.*

93. *See* Grannum v. Berard, 422 P.2d 812, 814 (Wash. 1967); *see also* James L. Werth Jr., G. Andrew H. Benjamin & Tony Farrenkopf, *Requests for Physician-Assisted Death: Guidelines for Assessing Mental Capacity and Impaired Judgment*, 6 PSYCHOL. PUB. POL'Y & L. 348, 354 (2000).

The MRPC lay out broad steps for lawyers wishing to determine capacity in a would-be client. First, they must host a preliminary screening to identify "red flags" for capacity.[94] If concerns about capacity are either absent or "mild . . . but they not substantial," representation can proceed.[95] If concerns are more than mild or substantial, the MRPC stipulate that the lawyer should consult with a professional or have a professional formally assess the patient.[96] This can be done after the lawyer has determined which questions to ask, which issues to measure, and the like.[97] Comment 6 to Rule 1.14 elaborates that, in making these assessments, lawyers should balance factors such as the would-be client's "ability to articulate reasoning leading to a decision; variability of state of mind and ability to appreciate consequences of a decision; the substantive fairness of a decision; and the consistency of a decision with the known long-term commitments and values of the client."[98] Throughout, lawyers must make decisions based upon the elements of legal capacity for the relevant transaction. They must also thoroughly document all capacity observations and remain vigilant against mitigating factors or deleterious biases that may cloud their judgment.[99] All of these tasks would take on increased importance when dealing with a client with a BCI.

Lawyers assessing BCI users for capacity may also take guidance from the Margulies/Fordham criteria.[100] These tests look to a variety of criteria to assess capacity, including the ability to articulate reasoning behind the decision, variability of state of mind, appreciation of consequences, substantive fairness of decision, consistency with lifetime values, and irreversibility of the decision — designed for patients with particularly questionable capacity.[101]

The legal assessment of capacity is explicitly not a clinical determination. While diagnostic tests can aid lawyers in designated instances, the American Bar Association ("ABA"), in fact, cautions against overuse of medical diagnostic tools.[102] It contends that clinical and legal models run closely enough together that lawyers need not defer to clinicians, as this can be time-consuming.[103] Moreover, lawyers can harm the nascent attorney-client relationship by suggesting outside

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94. *See* AM. BAR ASS'N COMM'N ON LAW AND AGING & AM. PSYCHOLOGICAL ASS'N, *supra* note 89, at 3.
95. *See id.*
96. *Id.*
97. *Id.*
98. *Id.*
99. *Id.* at 13.
100. *Id.* at 18–19.
101. *Id.*
102. *Id.* at 21–22.
103. *Id.*

clinical evaluation, and these lawyers are not trained to administer the tests themselves.[104]

The Grisso factors, meant for doctors to clinically evaluate capacity, exemplify the similarities between medical and legal assessments.[105] They include the cause of the condition and the patient's expected prognosis, cognitive awareness, and behavioral interactions.[106] The first factor is the cause of the condition and likely trajectory of improvement.[107] This is frequently also built into legal assessments. For the neurological conditions discussed above, which sometimes take several years to declare themselves prognostically, the ABA should follow medicine's example and implement a cautionary guideline against overly hasty assessments. Attorneys must also strive to recognize and resist any harmful stereotypes about neurologically disabled individuals.

The next factor is the patient's cognitive awareness.[108] Measured clinically with tests such as the Mini Mental Status Exam, legal elements of cognitive capacity are often captured in guardianship statutes, which require an assessment of a patient's understanding of their own situation.[109] Prototypical language appears in the 1982 and 1997 Uniform Guardianship and Protective Proceedings Acts, which instructs lawyers to focus on clients' ability to "receive and evaluate information or make or communicate decisions" or "sufficient understanding or capacity to make/communicate decisions."[110] Lawyers must keep in mind that, if would-be clients have a cognitive-motor dissociation, they may possess full capacity to *make* decisions but cannot ordinarily *communicate* them without a BCI. Because a BCI could allow potential clients to communicate solely via electrical impulses from their brains, bypassing parts of their body that prevent them from speaking, efforts should be made to provide would-be clients with the proper tools to facilitate communication.

Next, the Grisso factors turn to behavioral considerations.[111] For doctors in a clinical context, these are measured with tests specialized to the condition being evaluated, such as traumatic brain injury or mental illness.[112] Lawyers also use instruments designed specifically to measure capacity in several contractual or transactional domains, as the

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104. *Id.*

105. *Id.* at 9.

106. *Id.* at 9–11.

107. *Id.* at 9–10.

108. *Id.* at 10.

109. *See id.* at 10, 66; *see also* UNIF. GUARDIANSHIP & PROTECTIVE PROCEEDINGS ACT (Nat'l Conference of Comm'rs on Unif. State Laws 1997).

110. UNIF. GUARDIANSHIP & PROTECTIVE PROCEEDINGS ACT, *supra* note 109, at § 102(5).

111. *See* AM. BAR ASS'N COMM'N ON LAW AND AGING & AM. PSYCHOLOGICAL ASS'N, *supra* note 89, at 10–11.

112. *Id.*

elements of capacity in each are statutorily stipulated. The Hopemont Capacity Interview, for example, measures capacity to make medical decisions utilizing short interviews.[113] Finally, the Grisso factors analyze the patient's interactions, including context, personal relationships, consistency with lifelong values, and so on.[114]

As this comparison illustrates, law and medicine often seek to assess similar elements when judging capacity — understanding, appreciation, reasoning, and expression of choice — but achieve it through differing means. The law tends to focus attention on statutory definitions of capacity for any given transaction, focusing on bright-line rules and established rights. On the other hand, medicine is primarily concerned with capacity to consent (or assent) to procedures, and doctors work hard to attune themselves to subtleties of the patient's condition.[115]

B. Competence to Stand Trial

Competence to stand trial is a fundamental due process concern; one that American courts assimilated from their British counterparts.[116] The Supreme Court has clarified the meaning of "competent to stand trial" through a series of cases. In *United States v. Boylen*, the Court considered whether the defendant was "capable of properly appreciating his peril and of rationally assisting in his own defense."[117] The Court elaborated upon this in *Dusky v. United States*, asking whether the defendant possessed "sufficient present ability to consult with his lawyer with a reasonable degree of rational understanding — and whether he ha[d] a rational as well as factual understanding of the proceedings against him."[118] Finally, *Drope v. Missouri* went even further by asking, more broadly, whether the defendant was able to assist in his defense.[119] Increasingly, the legal profession has witnessed a push to-

113. *Id.* at 64–65.

114. *Id.* at 11.

115. *See* Franklin G. Miller, Robert D. Truog & Dan W. Brock, *Moral Fictions and Medical Ethics*, 24 BIOETHICS 453, 455–60 (2010).

116. *See* MICHAEL PERLIN, 3 MENTAL DISABILITY LAW: CIVIL AND CRIMINAL § 13-1 (3d ed. 2019).

117. United States v. Boylen, 41 F. Supp. 724, 725 (D. Or. 1941); *see also* PERLIN, *supra* note 116.

118. Dusky v. United States, 362 U.S. 402, 402 (1960).

119. *See* Drope v. Missouri, 420 U.S. 162, 171–72 (1975); *see also* W.J. Dunn, Annotation, *Validity and Construction of Statutes Providing for Psychiatric Examination of Accused to Determine Mental Condition*, 32 A.L.R.2d 434, 434 (West 2019).

wards instruments for measuring competency to operationalize this judicial guidance. Structured as inventories, interviews, or surveys, these tend to measure rationality and comprehension of the situation.[120]

While LIS patients and those with CMD and aphasia may be unable to communicate without assistance, their conditions do not uniformly hamper rationality or comprehension. Others with conditions affecting cognition to some degree have been found legally competent in other contexts.[121] In fact, defendants with traumatic brain injuries have been ordered to stand trial, as long as their impairment did not preclude a sufficient level of understanding of the proceedings.[122] Given this precedent, locked-in patients might not be categorically barred from standing trial, nor would those with aphasia and CMD. Rather, the question would focus on whether an individual has the requisite ability to understand their circumstances and assist in their defense. Of course, lawyers can only ascertain this by communicating with the patient, and in this population, that can only be achieved via some manner of BCI. This could lead to a question of whether a court should provide the means to patients with these communication disorders to actualize a right to be heard.

Indeed, courts have long been in the practice of using medical means to enable those found incompetent to stand trial. Witnesses or defendants who are too psychotic to testify, but without whom the trial cannot be held, are frequently "restored to reason."[123] Courts will defer to this option except when the defendant or witness is judged substantially unlikely to be restored to reason.[124] This underscores the value courts place on the ability to stand trial.

In light of these measures, proponents might argue that providing patients the ability to testify with a BCI is considered another method of reducing to reason. In a metaphorical sense, these cognitively intact but physically immobilized individuals have already been reduced to

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120. *See, e.g.*, Paul D. Lipsitt et al., *Competency for Trial: A Screening Instrument*, 128 AM. J. PSYCHOL. 105 (1977); Ames Robey, *Criteria for Competency to Stand Trial: A Checklist for Psychiatrists*, 122 AM. J. PSYCHOL. 616 (1965); THOMAS GRISSO & PAUL S. APPELBAUM, MACARTHUR COMPETENCE ASSESSMENT TOOL FOR TREATMENT (MACCAT-T) (1998); Robert I. Simon, *Ethical and Clinical Legal Issues*, *in* TEXTBOOK OF TRAUMATIC BRAIN INJURY 583, 586 (Jonathan M. Silver et al. eds., 1st ed. 2005).

121. *See* People v. Avila, 11 Cal. Rptr. 3d 894, 898 (Cal. Dist. Ct. App. 2004) (holding that chronic back condition and severe, painful headache did not prevent defendant from assisting in his defense).

122. *See* Harris v. Kuhlmann, 346 F.3d 330, 355 (2d Cir. 2003); *cf.* Georgia Dep't of Human Res. v. Drust, 448 S.E.2d 364, 364 (Ga. 1994) (holding that defendant with a TBI could be found incompetent on basis of this injury under statute on insanity/mental "retardation").

123. *See* Jackson v. Indiana, 406 U.S. 715 (1972); Karen L. Hubbard et al., *Competency Restoration: An Examination of the Differences Between Defendants Predicted Restorable and Not Restorable to Competency*, 27 LAW & HUM. BEHAV. 127 (2003).

124. *See* Hubbard et al., *supra* note 123, at 128.

reason by their condition. BCIs could potentially do much more to affirm personhood in this context, while being less invasive than pharmaceutical intervention that alters physiological functioning. Instead of altering an incompetent person's cognition to prepare them for trial, a BCI would enable already-lucid patients to manifest their competence and participate fully in the hearing.[125] However, whether a court would find this reasoning persuasive remains untested.

C. Evidence

1. Testifying Directly in the Courtroom

The Federal Rules of Evidence ("FRE") generally require witnesses to testify in person.[126] Thus far, the technological constraints of BCI designs have limited users' mobility, often to the room where the fMRI or screens are located. As EEG-based BCI and portable interface applications become more common, this will likely become less of a barrier to testimony in court.[127] Nevertheless, should a patient require a device like fMRI, which cannot easily be moved, or should they be medically unstable, they may still be able to testify from their hospital or bedroom. The Supreme Court has noted that, where in-person testimony would bring a victim face-to-face with their perpetrator and cause tremendous distress, live videoconferencing provides an acceptable alternative.[128] Thus, not all out-of-court statements are hearsay, and courts might permit the out-of-court statements of a BCI user who, for instance, could not leave the hospital or was tethered to technology.[129]

Even if the court did consider such an out-of-court statement hearsay, it still might be admissible under Rule 804 of the Federal Rules of Evidence. This allows for hearsay when the declarant is unavailable as a witness "because of death or a then-existing infirmity, physical illness, or mental illness[,]" which could plausibly include a locked-in

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125. As with pharmacological reduction to reason, users of BCI have the right to not incriminate themselves. One can easily imagine a situation in which the government forced one to stand trial with a BCI who did not have the competence to do so, knowing the testimony would be lackadaisical or even easy to intentionally misinterpret, and precautions should be taken against such a miscarriage of justice.

126. The covertly conscious who are denied due process may also have recourse under *Olmstead v. L.C. by Zimring*, 527 U.S. 581 (1999). This case upheld the principle that people residing in facilities must have appropriate community engagement. *Id.* at 607. While no litigation has cast this question from the realm of the hypothetical, policies that deny bail while awaiting the competency assessment could very likely falter under *Olmstead*.

127. *See* Jessica Lauren Haushalter, Note, *Neuronal Testimonial: Brain-Computer Interfaces and the Law*, 71 VAND. L. REV. 1365, 1373 (2018).

128. *See* Haushalter, *supra* note 127, at 1378; Maryland v. Craig, 497 U.S. 836, 841, 857 (1990).

129. *See* Haushalter, *supra* note 127, at 1378–79.

state or disorder of consciousness.[130] However, all uses of this provision are filtered through Rule 804(b)'s narrow exemptions.[131] Of special relevance to this population could be the exemption for statements under the belief of imminent death, especially if they believed they would soon be removed from life support. Jessica Lauren Haushalter also imagines a use of the exemption for statements against parties who wrongfully caused the declarant's unavailability.[132] If the opposing side harmed the declarant in attempted sabotage, leaving them in a condition where BCIs would be necessary to communicate, the declarant might still have their testimony heard under Rule 804(b).[133]

2. Using an Expert Witness

Until 1993, the *Frye v. United States* standard, which asked whether evidence has gained "general acceptance" by the community from which it arose, governed the introduction of expert testimony.[134] *Daubert v. Merrell Dow Pharmaceuticals, Inc.* overturned this standard, upholding FRE 702 and its mandate that expert testimony be not just relevant, but reliable.[135] The use of expert witnesses is currently governed by the *Daubert* standard, which has since been folded into updates to FRE 702.[136] It inquires whether the technique has been tested, whether it has been subjected to peer review and publication, the potential error rate in using the technique, the existence and maintenance of standards controlling its operation, and whether it has been generally accepted in the scientific community.[137] While these factors should assist judges in their decision-making, none alone is dispositive, and no accumulation of answers mandates a decision.[138] Indeed, a judge may choose to admit scientific evidence that falls short of *Daubert* if they deem it relevant to the proceedings. In such circumstances, the hope is that the adversarial machinery of the court will interrogate accuracy.[139]

It is unclear what this stance augurs for BCI in the immediate future. At the time of writing, should one side move to introduce expert

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130. FED. R. EVID. 804(a)(4).
131. FED. R. EVID. 804(b).
132. *See* Haushalter, *supra* note 127, at 1379–80.
133. *Id.*
134. Frye v. United States, 293 F. 1013, 1014 (D.C. Cir. 1923); *see also* Shapiro, *supra* note 30, at 541.
135. *See, e.g.*, Shapiro, *supra* note 30, at 541; Daubert v. Merrell Dow Pharm. Inc., 509 U.S. 579, 585–89 (1993).
136. FED. R. EVID. 702 advisory committee's note to 2000 amendment ("Rule 702 has been amended in response to *Daubert v. Merrell Dow Pharmaceuticals, Inc*. . . ."); *see also* Shapiro, *supra* note 30, at 541.
137. *See Daubert*, 509 U.S. at 580.
138. *Id.*
139. *See* Haushalter, *supra* note 127, at 1385.

testimony on BCI, the opposition would likely call its own expert. The ensuing debate would center on whether BCI is a reliable, generalizable, and accepted scientific practice.[140] Courts remain skeptical about admitting EEG and fMRI into evidence for many proposed legal uses,[141] as available data for both modalities, applying to general neuroimaging and BCI applications, are dogged by small sample sizes and inconsistent results. For instance, certain kinds of fMRI responses have not always been reproducible, a challenge for their *Daubert* admissibility even if they were to meet other factors.[142] While electrography of various sites on the body has long been in practice, and EEG has previously been accepted in courts,[143] newer applications of EEG, such as quantitative EEG, have floundered under courtroom scrutiny.[144]

To the authors' knowledge, no case has yet addressed a movement to introduce BCI evidence in court. However, BCI studies tend to have small sample sizes and lack a control group, as these devices are frequently customized for particular patients.[145] Given these small sample sizes, a question would arise concerning whether the evidence is prone to misinterpretation and thus inadmissible under *Daubert*.[146] In response, the side hoping to introduce the testimony might point to the conversational nature of a BCI, which, in the fashion of a Turing test, confirms the user's comprehension through a reproducible pattern of thematic, logical responses in conversation.[147] This, in turn, would serve as an instrumental calibration check on the validity of the neuroimaging, as it would be unlikely for a misfiring device or unconscious person to consistently respond appropriately and in a sophisticated manner. Nevertheless, the opposition could argue that the output was willfully misinterpreted. More subtly, they might suggest that their overeager opponents were somehow triggering a spurious response, much like the German townspeople, thrilled to see Clever Hans the horse calculate math problems, actually induced him to select the right answer by their reactions to his hoofs hitting the ground.[148] The presiding judge would need to evaluate the evidence and exercise the discretion allowed by *Daubert*.

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140. *See generally* FED. R. EVID. 702.

141. *See generally* Shapiro, *supra* note 30.

142. *Id.* at 543.

143. *See* People v. Alerte, 458 N.E.2d 1106, 1110 (Ill. App. Ct. 1983).

144. *See* Ross v. Schrantz, No. C8-94-1729, 1995 Minn. App. LEXIS 586, at *1, (Minn. Ct. App. May 2, 1995).

145. *See* Jarosiewicz et al., *supra* note 16.

146. *See* Shapiro, *supra* note 30, at 538, 547.

147. *See* A. M. Turing, *Computing Machinery and Intelligence*, 49 MIND 433, 433–34 (1950) (discussing the Turing Test for recognizing artificial intelligence).

148. *See* Laasya Samhita & Hans J Gross, *The "Clever Hans Phenomenon" Revisited*, COMMUNICATIVE & INTEGRATIVE BIOLOGY, Nov.–Dec. 2013, at e27122-1, e27122-2 (2013).

Another strategy would be to rebrand the BCI testimony not as scientific evidence, but rather physical/machine evidence or akin to the use of a translator. Lawyers could, arguing that all machines are to some degree interfaces and that machines are not treated as scientific evidence, request that communicative BCIs be treated no differently.[149] For example, some courts have permitted machines, such as guns, to be introduced as physical evidence rather than scientific evidence, thus bypassing the *Daubert* test.[150] Were this argument to succeed, though, the BCI would likely — and prudently — be subjected to a reliability test before its "machine assertions" could be evaluated in court.[151] Given that a BCI may involve more points of dynamic human interaction than, for instance, a gun, or some other tool more commonly evaluated under this framework, the BCI may not pass the reliability test.[152]

Alternatively, an analogy could be drawn to the fact that courts permit translators for witnesses who are deaf or not proficient in English.[153] Given that BCI serves a similar function and allows a patient to communicate testimony, not to opine on a scientific matter, an advocate could present the testimony as normal evidence procured by the equivalent of an interpreter or facilitator.[154] They could argue, moreover, that interpreting BCI output is unlike interpreting a regular brain scan because it requires no opinion on, for instance, proclivities to criminal behavior.[155] The expert witness would need to be "qualified and . . . give an oath or affirmation to make a true translation," as per FRE 604, which addresses interpreters.[156] The matter they would be interpreting, however, would be the presence of a trained signal and that signal's meaning within the BCI, just as regular translators testify on the meaning of sounds or words in other languages.

Some may argue against the wisdom of including neuroscience evidence at all, out of fear that it will irrationally sway the jury.[157] However, we believe that such fears are excessive. One of us has observed that FRE 403 requires the court to exclude evidence if its "probative value is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury."[158] Prominent studies have suggested that neuroscientific evidence is weighted heavily by lay

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149. *See* Haushalter, *supra* note 127, at 1391.
150. *Id.*
151. *Id.*
152. *Id.*
153. *See* FED. R. EVID. 604.
154. *See* Haushalter, *supra* note 127, at 1383.
155. *Id.*
156. *See* FED. R. EVID. 604; *see also* Haushalter, *supra* note 127, at 1383.
157. *See, e.g.*, Jennifer Chandler, *The Autonomy of Technology: Do Courts Control Technology or Do They Just Legitimize Its Social Acceptance?*, 27 BULL. SCI. TECH. & SOC'Y 339, 340 (2007).
158. *See* Shapiro, *supra* note 30, at 544–45; FED. R. EVID. 403.

jurors regardless of the quality of its content,[159] indicating that neuroscientific reasoning made bad arguments seem better to laypeople,[160] and that brain scans may be more convincing to laypeople than other sorts of neuroscientific evidence.[161] However, many of these studies have occurred outside of the legal or judicial context, where additional supports exist for debunking poor argumentation. Jennifer Chandler has found that, whenever neuroscience evidence was used in any Canadian court between 2008 and 2012, it did have an effect on findings of moral blameworthiness and perceptions of dangerousness.[162] Overall, meta-analyses return ambivalent responses on whether the mere presence of neuroscience evidence can turn a juror's mind.[163] Controlling for other factors, the ambiguous level of risk to sound decision-making might not be enough to overpower the probative value and due process imperative of BCI evidence, given the additional calibration check that comes from their comprehension-displaying output.

In sum, a strong legal and moral imperative could one day exist for including BCI evidence in trial. However, the current state of the technology makes it unclear whether such a motion would succeed. Better, more expansive research can pave the way for its future inclusion. However, until judges begin the difficult task of actually considering BCI evidence, we can only speculate as to a court's reaction.

V. BCI AND CLINICAL PRACTICE

BCI's novelty and the communication challenges posed by LIS, aphasia, and CMD may unnerve clinicians and cause them to act with an excess of caution when considering BCI-based prosthetic communication. Instead of applying standards applicable to everyday life exchanges, clinicians may seek the protective refuge of strict legal standards more appropriate for end-of-life decisions than everyday care. This would prove problematic, as most exchanges with BCI users will be quotidian, not monumental. BCI users, like other patients, will

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159. *See* Deena Weisberg et al., *Deconstructing the Seductive Allure of Neuroscience Explanations*, 10 JUDGMENT & DECISION MAKING 429, 435 (2015).

160. *See* Deena Weisberg et al., *The Seductive Allure of Neuroscience Explanations*, 20 J. COGNITIVE NEUROSCIENCE 470, 470 (2008); *cf.* Robert Michael et al., *On the (Non) Persuasive Power of a Brain Image*, 20 PSYCHONOMIC BULL. & REV. 720, 720 (2013).

161. *See* D.P. McCabe & A.D. Castel, *Seeing Is believing: The Effect of Brain Images on Judgments of Scientific Reasoning*, 107 COGNITION 343, 349–51 (2008).

162. *See* Jennifer Chandler, *The Use of Neuroscientific Evidence in Canadian Criminal Proceedings*, 2 J.L. & BIOSCIENCES 550, 564 (2016).

163. *See, e.g.*, Shapiro, *supra* note 30, at 544–45; Darby Aono, Gideon Yaffe & Hedy Kober, *Neuroscience in the Courtroom: A Review*, COGNITIVE RES.: PRINCIPLES & IMPLICATIONS, 2019, at 1; David Gruber & Jacob A. Dickerson, *Persuasive Images in Popular Science: Testing Judgments of Scientific Reasoning and Credibility*, 21 PUB. UNDERSTANDING SCI. 938, 938 (2012); Martha Farah & Cayce J. Hook, *The Seductive Allure of "Seductive Allure"*, 8 PERSP. PSYCHOL. SCI. 88, 90 (2013).

want their bedding changed, or the blinds opened, or the television turned on. Applying the same evidentiary standard to these choices as to ones governing end-of-life decisions will, at best, unfairly limit BCI users' ability to communicate and express their agency. At worst, restrictive standards will infantilize the patient and stifle their reemergent agency. The following section considers how capacity and competency determinations can respond flexibly in the clinic and treat BCI users as much as possible like other patients who are similarly situated.

A. Capacity

Scholarship and existing case law concerning informed consent can guide BCI cases.[164] Case law specifies the level of information that a patient ought to have before providing informed consent to a procedure: that of a "reasonable patient," or reasonable patient seen through the eyes of a reasonable physician.[165] The patient must be free from coercion and capable of acting voluntarily.[166] They must be apprised of all risks, benefits, and alternatives. Meisel, Roth, and Lidz, in one of the first legal papers on informed consent for a medical audience, propose two models of informed consent by which a physician can ascertain a patient's understanding.[167] The "objective model" depends upon a person's "generalized ability to function in the world" and posits a reasonable person standard for inferring decision-making ability.[168] Conversely, the "subjective model" asks whether the patient actually understands the information their physician has offered. The Meisel framework punctuates two concepts. First and most obviously, physicians should always default to the subjective model when dealing with BCI users who cannot ordinarily function independently.[169] Second, the medical community should offer guidelines concerning ways for a clinician to tell that a BCI user actually comprehends information.[170]

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164. *See, e.g.*, Joseph J. Fins, *Ethical, Legal, and Psychiatric Issues in Capacity, Competence, and Informed Consent: An Annotated Bibliography of Representative Articles*, 18 GEN. HOSP. PSYCHIATRY 155 (1996) (summarizing articles from 1977 to 1996 on the doctrine of informed consent).

165. *See* Alan Meisel et al., *Toward A Model of the Legal Doctrine of Informed Consent*, 134 AM. J. PSYCHIATRY 285, 285–86 (1977) (describing case law on the doctrine of informed consent); Schloendorff v. Soc'y of N.Y. Hosp., 105 N.E. 92, 93 (N.Y. 1914).

166. *See* Meisel et al., *supra* note 165, at 286.

167. *Id.*

168. *Id.* at 287.

169. *Id.*

170. *Id.*

Another influential school of thought, championed by the scholar James Drane, advocates for construing capacity as a "sliding scale" rather than a construct to toggle on and off.[171] Drane's model incorporates a patient's wishes by the standards of "assent," "understanding," or "appreciation." These are increasingly stringent and, according to Drane, contextualized against situations of escalating risk.[172] Assent requires only general awareness of the treatment, and it attaches to either low-risk situations or lifesaving procedures with no alternative, where the rational medical judgment is undisputed.[173] In contrast, understanding defines a situation where a chronically ill patient must decide on an issue where rational medical opinion is divided. It requires, beyond the "general awareness" of assent, a decision founded on comprehension of the risks and outcomes of various alternatives, and an absence of cognitive impairments.[174] Drane notes that decisions may be expressed either verbally or affectively, with clinicians attending to psychological cues that betray bases for decisions, such as emotional or physical anguish.[175] When working with BCI patients, clinicians ought to be attuned to their unique hardships and ensure that their decisions are coming from reasoned understanding, not transient pain or worry. Finally, Drane reserves the standard of appreciation for risky decisions that run contrary to professional judgment.[176] A patient wishing to reject sound medical reasoning in favor of likely harm must be able to express the realities of treatment and how this relates to their personal value system. This would set a high standard for a BCI user to meet, and so physicians must both be certain that the user is proficient in communicating with the device, that the application is properly calibrated, and that they are holding the conversation and interpreting the output properly.

Similarly, Schwartz and Blank view capacity as an ongoing determination to be repeated throughout the course of the patient's stay, based upon mental status and changes in treatment.[177] Multiple standards should be used, as they are likely to capture more than the factual understanding test can by itself.[178] This model would be especially crucial for degenerative diseases like ALS and cyclical conditions with

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171. *See* James F. Drane, *The Many Faces of Competency*, HASTINGS CTR. REP., Apr. 1985, at 17 (1985). Drane refers to this as "competence," but modern terminology would understand it as capacity, as he is not specifically addressing a legal standard for substituted decision-making.

172. *Id.* at 18.

173. *Id.*

174. *Id.*

175. *Id.* at 20.

176. *Id.*

177. *See* Harold I. Schwartz & Karen Blank, *Shifting Competency During Hospitalization: A Model for Informed Consent Decisions*, 37 HOSP. & COMMUNITY PSYCHIATRY 1256, 1256 (1986).

178. *Id.*

fluctuating levels of arousal as in MCS. These individuals may only display intermittent and non-reproducible signs of consciousness, necessitating a longer timeline for consideration and detection of capacity. A longer timeline will allow clinicians to catch any changes in mental status, which might compromise an individual's ability to utilize a BCI.

In addition to verbal standards, physicians also utilize instruments to gauge capacity. Like lawyers, they interrogate patients along the Grisso factors, mentioned *supra* in Section IV.A.[179] Increasingly, they may opt instead for the MacArthur Competence Assessment Tool for Treatment, a script that informs the patient about their condition, the proposed intervention, and any alternatives, while prompting the clinician with questions probing for patient comprehension and rationale.[180] Of course, using such an instrument may pose special challenges when the patient is a BCI user; interviewers must remain mindful of comorbidities that may affect BCI users' communication abilities, as well as psychological or motivational factors that may be dissuading them from demonstrating competence.[181]

This model is more subtle than legal representation, which forces a binary choice of either having capacity for a particular transaction or not. This model allows physicians to gauge patients' understanding and involve them to the greatest possible extent in decisions about their health, without forcing them into a binary classification scheme. In this way, clinicians maximize the ability of a patient to participate in decisions and try to identify those domains in which patient participation is possible. This allows them to contextualize capacity standards to the clinical context.

All of these models can be applied to decisions and preferences expressed by an individual with a BCI. These different models all underscore the importance of verifying patients' comfort with their BCI devices and of building calibration checks into any BCI. They also demonstrate the importance of having clinicians who are conversant with BCI users, as these devices may, at least at first, hamper their expression of emotions or complicated ideas. Moreover, these theories comfortably accommodate BCI communicative prosthetics, revealing that BCI can be considered within a standard clinical framework.

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179. *See* Paul S. Appelbaum & Thomas Grisso, *Assessing Patients' Capacities to Consent to Treatment,* 319 NEW ENG. J. MED. 1635, 1637 (1988).

180. *See* Terry A. Maroney., *Emotional Competence, 'Rational Understanding,' and the Criminal Defendant,* 43 AM. CRIM. L. REV. 1375, 1389 & n.82 (2006) ("The MacArthur Competence Assessment Tool-Criminal Adjudication ('MacCAT-CA') is the first competence assessment instrument to seek to measure decision-making capacity directly.").

181. *See* Appelbaum & Grisso, *supra* note 179, at 1635–37.

B. Competence and Substituted Decision-Makers

Unlike capacity, which can be judged for both medical and legal purposes, competence is explicitly a legal determination. States codify the standards of competence at which different kinds of decision-makers must be appointed.[182] This is because a juridical determination of incompetence deprives an individual of the civil liberty to make choices for oneself and places that locus of decision-making on a surrogate decision-maker or the court. While doctors have some expertise in considering and evaluating competence, BCI users will present unique complications in this assessment.

When assessing a BCI user's competence, like any patient, clinicians must consider many factors. Appelbaum and Roth observe that these include the patient's personality and psychodynamic considerations, including concealed motives or desires; the accuracy of information provided both by the patient to the clinician and to the clinician by the patient; the long-term stability of the patient's mental status; and the setting in which the decision is to be made.[183] An evaluation seemingly yielding a finding of incompetency should be repeated at varying intervals to exclude the possibility of improper timing.

Clinicians must remember potential psychological vulnerabilities of a BCI user, as a formerly overlooked individual adjusting to a new way of life. Mahler and Perry advocate for a four-step process, comprising a clinical evaluation, staff and patient interventions, treatment recommendations, and documentation in the medical record.[184] At each juncture, Mahler and Perry advise clinicians to screen for such issues as depression, denial, or conflicts with clinical staff.[185] This exemplifies how, even within a standardized and rules-based framework, clinicians can be sensitive to subtle or developing issues.

C. Evidence and Epistemic Humility

Bardin et al. relate the case of an fMRI-communicating MCS patient who responded consistently, but incorrectly, to every question asked of them.[186] Perplexed, the researchers sampled a different analysis with a fixed time delay, which then revealed the patient's correct

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182. *See* OFFICE OF THE STATE LONG-TERM CARE OMBUDSMAN, IOWA DEP'T ON AGING, CAPACITY VS. COMPETENCY (2016).

183. *See* Paul Appelbaum & Loren H. Roth, *Clinical Issues in the Assessment of Competency,* 138 AM. J. PSYCHIATRY 1462, 1463–65 (1981).

184. *See* John Mahler & Samuel Perry, *Assessing Competency in the Physically Ill: Guidelines for Psychiatric Consultants*, 39 PSYCHIATRIC SERVS. 856 (1988).

185. *Id.*

186. *See* Joseph J. Fins, *Wait, Wait . . . Don't Tell Me: Tuning in the Injured Brain*, 69 ARCHIVES NEUROLOGY 158 (2012).

responses.[187] The Bardin data reveals that the injured brain may not respond as rapidly, as consistently, or in the same manner as that of a neurotypical patient; in all likelihood, neural activity may deviate from outsiders' expectations.[188] This deviation suggests that, as incipient BCI technology continues to develop, we must remain vigilant against error or misunderstanding. Early considerations of BCI will reflect not just the novelty of the tool, but also a tension between confidence and compassion.

Neurotypical, able-bodied interlocutors will require a level of certainty that the message they receive accurately depicts the BCI user's intention. They are accustomed to the ease of ordinary conversation and perhaps nurse some techno-skeptical attitudes. Consequently, they may perceive unexpected responses as evidence that the patient is not really conscious or that the device is malfunctioning.

While we cannot hope to achieve absolute certainty in our conversations with BCI users, we can achieve more success if we approach these conversations with respect, seeking to learn the language of those dependent upon neuroprosthetic communication. This will require a shift from a futility heuristic to the neuro-rehabilitation model.[189] Speaking the language of the brain-injured also requires accommodating obstacles that these patients face in communicating, something that comes to most of us naturally. Such miscommunications can be catastrophic in BCI users, who have no way to correct for them. Thus, the burden falls to lawyers, clinicians, and the rest of society to learn how to ask the right questions — and to wait for a response.

VI. Obligations of Others

The disability rights movement's rallying cry remains "nothing about us without us."[190] Elsewhere, we have written on the importance of viewing brain injury through the disability rights lens.[191] Though BCI technology's novelty may, at first, challenge both medical and legal professionals, BCI users will eventually come to be understood through conventional frameworks, whether it be the clear-cut rules of the legal field or the flexibility and creativity of the clinic. Nevertheless,

187. *Id.*

188. *Id.*

189. *See, e.g.*, Megan S. Wright & Joseph J. Fins, *Rehabilitation, Education, and the Integration of Individuals with Severe Brain Injury into Civil Society: Towards an Expanded Rights Agenda in Response to New Insights from Translational Neuroethics and Neuroscience*, 16 Yale J. Health Pol'y L. & Ethics 233 (2016).

190. *See generally* James I. Charlton, Nothing About Us Without Us: Disability Oppression and Empowerment (Univ. of Cal. Press 1998) (discussing the origin of the phrase and rally calls of the movement).

191. *See, e.g.*, Wright & Fins, *supra* note 189, at 251–57 (presenting novel legal argument asserting a right to rehabilitation). *See generally* Fins, *supra* note 8.

engaging these reemergent voices in decisions about their health and in the machinery of the law requires doctors, lawyers, and loved ones learning how to interact with BCI users. To this end, before BCI technology is widespread, law and medicine must engage with patients with neurological conditions to help ensure that emerging technology meets their needs. [192]

Fundamentally, both law and medicine must acknowledge their obligations to learn the language of assistive communicative devices. Only in this way can we encourage and heed a reemergent voice. However, while existing legal and medical frameworks can adapt to issues surrounding BCI, certain changes in convention could kick start the process of ensuring that all communications, including those using neuroprosthetic devices, receive the respect they deserve. Only in this way can the BCI patient truly exercise their right to be heard.

When determining capacity or competence, clinicians — and lawyers to the extent possible — should employ the technique of mosaic decision-making, engaging the patient insofar as they are able, along with a surrogate who knows them well, as opposed to charging a surrogate with unilateral power.[193] This mixed approach to decision-making can better account for the variety of factors influencing any given decision, while reducing the burden on surrogates and family to stand-in for their loved one's voice. The ABA should consider updating its MRPC guidelines for interviewing BCI patients, and ideally, judges should receive some basic training on this emerging technology and how it functions. Not only is comprehension the antidote to fear-based retreats into formalism, but this will also promote empathy and understanding. For this same reason, when appropriate and as resources allow, as many doctors, lawyers, and family members as feasible should be trained to use BCI.

Finally, we must strive to normalize assistive technologies and avoid framing BCI users as anything other than fully human. We must recognize that using devices to extend our own capabilities and perceptions, thus transforming the device into an extension of our own bodies, is a normal mode of human functioning within the world. A blind person with a cane and a teenager with a smartphone both learn to perceive affordances, or access opportunities, that would have gone unnoticed by a system merely consisting of their own flesh and blood.[194] BCI technology is only one application of this reality. Its use does not

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192. *See* Joseph J. Fins, *A Narrative of Advocacy, Resilience, and Recovery Following Severe Brain Injury*, 34 J. HEAD TRAUMA REHABILITATION 364, 365 (2019); *cf.* Leslie C. Griffin, *Conquering Brain Injury*, 34 J. HEAD TRAUMA REHABILITATION 366, 366–67 (2019) (describing the difficulties of coping with a neurological condition).

193. *See* Fins, *Reemergent Agency*, *supra* note 88, at 168–69.

194. *See generally* MAURICE MERLEAU-PONTY, PHENOMENOLOGY OF PERCEPTION (Donald A. Landes trans., Routledge 2012).

threaten a futuristic world of non-human cyborgs and "unnatural" communication, only a more accepting community cognizant of our many differing abilities and skills.

In a 1928 address to the New York Academy of Medicine, Benjamin Cardozo, then Chief Judge of the New York State Court of Appeals, observed that law and medicine, despite their historic paths, had common origins:

> There are those who say that the earliest physician was the priest, just as the earliest judge was the ruler who uttered the divine command and was king and priest combined. Modern scholarship warns us to swallow with a grain of salt these sweeping generalities, yet they have at least a core of truth. Our professions — yours and mine — medicine and law — have divided with the years, yet they were not far apart at the beginning.[195]

Just as Cardozo observes, medicine and the law cohere around a common purpose.[196] Ensuring the dignity and respect of patients who depend upon BCI to communicate is a multifaceted task, and neither priestly tradition, law nor medicine, can achieve this alone. While lawyers will accomplish this by analogical reasoning and bright-line rules, clinicians can exercise the flexibility that has always permitted them to uphold their standard of care. Together, these two professions can promote respect for assisted communication, and balance justice and reason with compassion and care.

VII. CONCLUSION

BCI technology is a growing market: analysis by Reports and Data predicts the market size of BCI technology will reach $1.15 billion by 2026,[197] DARPA has launched its Next-Generation Nonsurgical Neurotechnology ("N3") program,[198] and a bevy of neural implant startups,

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195. *See* Benjamin Cardozo, *Anniversary Discourse: What Medicine Can Do for the Law,* 5 BULL. N.Y. ACAD. MED. 581, 581 (1929).

196. *See* Joseph J. Fins, *What Medicine and the Law Should Do for the Physician-Assisted Suicide Debate*, 44 CCAR J. 46, 46–47 (1997).

197. *Brain-Computer Interface Market to Reach USD 2.67 Billion by 2026*, GLOBENEWSWIRE (July 22, 2019, 11:21 AM), https://www.globenewswire.com/news-release/2019/07/22/1885929/0/en/Brain-Computer-Interface-Market-To-Reach-USD-2-67-Billion-By-2026-Reports-And-Data.html [https://perma.cc/27JV-SWLU].

198. Shelly Fan, *DARPA's New Project Is Investing Millions in Brain-Machine Interface Tech*, SINGULARITY HUB (June 5, 2019), https://singularityhub.com/2019/06/05/darpas-new-project-is-investing-millions-in-brain-machine-interface-tech [https://perma.cc/AQ2K-UD2W].

including Elon Musk's buzzed-about Neuralink, has attracted investors.[199] As discussed above, use cases for prosthetic communication devices continue to expand as the technology becomes more precise and better attuned to patient needs. Researchers will continue to seek to apply BCI in other medical conditions.[200] The gaming community is already using non-invasive BCI technology for more immersive experiences.[201] Software developers have also begun experimenting with applications of BCI for the "internet of things," or "IoT."[202]

As BCI technology becomes more commonplace, the complexity of the accompanying ethical issues will similarly intensify. A running theme of this Article, and likely trend for the future of this topic, is the evolving relationship between science and the law. While the law must do what it can to engage in anticipatory governance, we cannot hope to predict every ethical and legal issue that will arise moving forward. However, it is our hope that the framework laid out in the foregoing sections will continue to underpin ensuing debates on BCI usage. Research must advance to the point where legal professionals feel comfortable drawing inferences from BCI-based conversations, while law must assimilate scientific reasoning and embrace new precedents.

Similarly, strict evidentiary standards should not impede worthy efforts to use neuroprosthetic technologies — here BCI — to give voice to those made voiceless by injury or illness. To place strictures on their renascent efforts to communicate, aided by emerging technology, will silence them again and further marginalize those already sequestered. Their communicative acts need to be understood differently than those evaluated in a court of law. Indeed, to apply the wrong evidentiary standard in either a legal or clinical context deprives this promising technology of its maximal instrumentality.

Achieving this balance will allow both medicine and the law to positively incorporate new technological advances to achieve ultimate respect for persons and to advocate in every sense for their well-being.

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199. *21 Neurotech Startups To Watch: Brain-Machine Interfaces, Implantables, and Neuroprosthetics,* CB INSIGHTS RESEARCH BRIEFS (Jan. 28, 2019), https://www.cbinsights.com/research/neurotech-startups-to-watch [https://perma.cc/G2G2-RSSK].

200. GLOBENEWSWIRE, *supra* note 197.

201. *Id.*

202. *Id.*